**Citation:**

Kamphuis CB, Giskes K, de Bruijn GJ, Wendel-Vos W, Brug J, van Lenthe FJ. Environmental determinants of fruit and vegetable consumption among adults: a systematic review. Br J Nutr. 2006 Oct;96(4):620-35.

**PubMed ID:** 17010219

**Study Design:**

Systematic Review

**Class:**

M - Click here for explanation of classification scheme.

**Research Design and Implementation Rating:**

POSITIVE: See Research Design and Implementation Criteria Checklist below.

**Research Purpose:**

Summarise the existing empirical evidence pertaining to environmental infludences on fruit and vegetable consumption.

**Inclusion Criteria:**

- observational studies published in English between January 1, 1980 and December 31, 2004;
- studies conducted among population-based sample of adults 18 - 60 years old;
- studies being conducted in an "established market economy" as defined by the World Bank;

**Exclusion Criteria:**

- intervention studies
- studies with a research design that do not identify the effects of several environmental determinants on the outcome behaviour.
- studies among children.

**Description of Study Protocol:**

**Recruitment**

Scientific papers and reference lists of selected papers were systematically searched for observational studies among adults (18-60 years old), published in English between January 1, 1980 and December 31, 2004, with environmental factors as independent fasctor and fruit intake, vegetable intake or FV intake combined as one outcome measure.

**Design**

Systematic Review

**Blinding used (if applicable)**

none

**Intervention (if applicable)**

none

**Statistical Analysis**

Relative Risk of Association

Variance

**Data Collection Summary:**

**Timing of Measurements**

January 1, 1980 to December 31, 2004

**Dependent Variables**

- Variable 1: fruit intake
- Variable 2: vegetable intake
- Variable 3: fruit and vegetable intake

**Independent Variables**

environmental factors:

1. accessibility and availability, including physical and financial accessibility of products and shops that are needed for an (un)healthy diet;
2. social conditions including social relationships;
3. cultural conditions, including culture-specific eating patterns, health value orientations, food experiences in childhood and cultural participations;
4. materials conditions, including financial situation, material and social deprivation, and unfavorable working housing and neighborhood conditions.

**Control Variables**

age

sex

**Description of Actual Data Sample:**

**Initial N**: 67

**Attrition (final N):**

24 studies

**Age**:

18 years - 60 years

**Ethnicity**:

white

black

**Other relevant demographics**:

family status

marital status

household income

job status

household and neighborhood conditions

**Anthropometrics**

not given

**Location**:

USA

UK

Europe(Norway,Spain)

Australia

**Summary of Results:**

Key Findings

- Thirteen studies examined fruit and vegetables intake separately.
- Nine studies examined combined fruit and vegetable intakes.
- Two studies presented results for all three outcomes.
- Nine studies examined the associations between environmental determinant and dietary outcome for men and women separately.
- One study compared subgroups of blacks and whites.

Key Findings:

- 24 studies examined 97 associations between environmental determinants and intakes.
- 57 associations were statistically significant.
- household income was investigated in six studies that showed, in general, consistent positive associations with FV intake.
- Being married and residing in an advantaged area showed positive but not always significant associations with FV consumption in at least three studies of acceptable quality.
- Good local availability of FV also seemed to be positively related to intake, although the evidence was limited.
- Although studies were often of low quality, living in the north of the UK is not beneficial for one's FV consumption compared to living in other parts of the UK. or living in Greece.
- Seasonal influences showed mixed associations with intakes.

Table 2: Summary of the number of associations between environmental determinants and fruit and vegetable(FV) consumption

| Environmental determinants | Fruit Intake | Vegetable Intake | FV Intake | Significance |
|---|---|---|---|---|
| **Accessibility factors** | | | | |
| Supermarket in the census tract | | | + 1 | |
| Perceived accessibility(of shop, of FV in shops) | | | + 1 | |
| Perceived Affordability | | | + 1 | |
| Household food insecurity | - 1 | - 1 | | |
| Having a vegetable garden or home-grown produce | + 1 | + 1 | + 2 | |
| **Social factors** | | | | |
| Being married | + 1 | + 2 | + 2 | |
| Household size | + 1 | + 1 | | |
| Having children (compared with no children) | + 1/ -2 | - 1/ + 1 | | |
| Social support from family members | | | + 1/ + 1 | |
| Social support from others | | | + 1 | |
| Cultural factors | | | | |
| Presence of others during mealtime | + 1 | | | |
| Intellectual-cultural orientation of family | | | + 1 | |

| | | | |
|---|---|---|---|
| **Material factors** | | | |
| Median income of a neighborhood | + 1 | | |
| Neighborhood deprivation | - 1 | - 1 | - 1 |
| Household income | + 4 | + 7 | + 1 |
| Receiving benefits | | | - 2 |
| **Other factors** | | | |
| Living in a rural area | | | - 2 |
| Living in a northern region of Norway | | - 1 | |
| Living in the north of the UK | - 1 | - 1 | + 1 |
| Living in London/South-east of the UK | | | + 1 |
| Residing in the USA | + 1 | - 1 | |
| Residing in Scotland | - 1 | - 1 | - 1 |
| Winter | | - 1 | |

+, positive associations between environmental determinant and dietary outcomes

-, negative associations between enviromental determinant and dietary outcomes

Key Findings:

- Having a vegetable garden was positively and significantly associated with fruit consumption.
- Participants with food insecurity had a likelihood of 0.57 (CI 0.36,0.90) for consuming fruit daily compared with their counterparts who were food secure.
- Being married plus having a child, or being single plus having a child was positively and significantly associated with fruit consumption among whites.
- Participants with children were .90 times more likely to consume fruits seldomly than were participants without. Participants in households with more than 2 people were 1.54 times less likely to consume fruits seldomly.
- Eating with others was positively associated with fruit consumption.
- Men in the poorest neighborhood were 1.67 times more likely to significantly consume less fruit than those in the most advantaged neighborhoods.
- Residents of disadvantaged areas consumed 3.4 fewer servings of fruit per week compared with those living in most advantage areas.
- Men and women in the lowest income quintile consumed 77g and 73 g less fruit (respectively) in the previous 24h than their counterparts in the highest quintile.
- Men and women in the lowest quintile were 2.3 and 2.5 times more likely (respectively) not to consume vegetables on a daily basis.
- When moving to the USA, the frequency of fruit consumption increased from twelve to fifteen times a week compared with when living in the Asian country of origin.
- Moving to Scotland from Greece resulted in 40% of the students changing their fresh fruit consumption from ≤ once daily to < once daily.
- Participants in the North West of the UK consumed 0.39 portions fewer than those in the south west.

Table 3: Results of studies examining environmental determinants of fruit consumption

| **Environmental determinants** | Relative Importance | CI | Sample size (response rate) | significance P≤0.05 |
|---|---|---|---|---|
| **Accessibility factors** | | | | |
| Household food insecurity | 0.57 | 0.36,0.90 | 431(87) | Y |
| Having a vegetable garden or home-grown produce | | | 592(82%) | Y |
| **Social factors** | | | | |
| Being married and parental status | | | 595(82%) | Y |
| Having children, marital | | | 35,367(58%) | Y |
| Having children(compared with no children), household size | | | 14960(77%) | Y |

| | | | | |
|---|---|---|---|---|
| **Cultural factors** | | | | |
| Presence of others during mealtime | | | 592(82%) | Y |
| **Material factors** | | | | |
| Median income of a neighborhood | | | 13095 | Y(men) |
| Neighborhood deprivation | | | 691 | Y |
| Household income | | | 8883 (61%) | Y (men & women) |
| Household income | | | 7695(61%) | Y(men & women) |
| **Other Factors** | | | | |
| Residing in the USA for a minimum of 6 months | | | 63(53%) | Y |
| Residing in Scotland instead of Greece | | | 80(95.2%) | Y |
| Region of residence in UK | | | 35,367(58%) | Y(women) |

Key Findings:

- Having a vegetable garden was positively and significantly associated with vegetable consumption.
- Participants with food insecurity had a likelihood of 0.43(CI 0.25-0.74) for consuming vegetables daily compared with their counterparts who were food-secure
- Being married + having a young child (v. being single + having a young child) was positively and significantly associated with vegetable consumption.
- Those without children consumed 0.17 portions fewer than participants with children. Single participants consumed 0.60 fewer portions of vegetables than their married counterparts.
- Those with children were -0.15 times less likely to be frequent consumers of vegetables than participants without, not significant. Participants in households with more than two people were 1.11 times more likely to be frequent vegetable consumers than those living alone, significant.
- Residents of deprived areas reported consuming 2.2 servings fewer of vegetables per week than those in advantaged areas.
- Men and women in the lowest income quintile consumed 18g and 16g fewer vegetables (respectively) in the previous 24h than did their counterparts in the highest income quintile.
- Men and women in the lowest quintile were 1.6 times more likely not to consume vegetables on a daily basis.
- Men and women in low-income households were 1.54 and 1.42 times more likely to be low vegetable consumers (respectively than those in high-income households).
- High-income groups were -.089 times less likely to consume vegetables seldomly than low-income groups.
- When moving from an Asian country to the USA, the frequency of vegetable consumption decreased from twenty-six to twenty-one times per week.
- Moving to Scotland (from Greece) resulted in 52% of the students changing their raw vegetable consumption from once or more per day to less than once per day.
- Participants in the north-west consumed 0.32 portions fewer than those in the south west.
- Those living in the north of Norway were -0.73 tmes less likely to be frequent vegetable consumers than those living in Oslo.
- Vegetable consumption was 45g lower in winter than summer.

Table 4: Results of studies examinging environmental determinants of vegetable consumption

| Environmental determinants | Relative | CI | sample size | significance $p \leq 0.05$ |
|---|---|---|---|---|
| **Accessibility factors** | | | | |
| Household food insecurity | 0.43 | 0.25-0.74 | 431(87%) | Y |

| | | | | |
|---|---|---|---|---|
| Having a vegetable garden | | | | Y |
| **Social factors** | | | | |
| Being married and parental status | | | 592(82%) | Y |
| Having children, marital status | | | 35367(58%) | Y(women only) |
| Having children(compared with no children), household size | | | 14,960(77%) | Y (household only) |
| **Material factors** | | | | |
| Living in a deprived v. advantaged area | | | 691 | Y |
| Household income | | | 8,883(61%) | Y(men and women) |
| Household income | | | 7,695(61%) | Y(men and women) |
| Household income | | | 1,992(70%) | Y(men and women) |
| Household income | | | 14,960(77%) | Y |
| **Other factors** | | | | |
| Residing in the USA for a minimum of 6 months instead of residing in an Asian country | | | 63(53%) | Y |
| Residing in Scotland instead of Greece | | | 80(95.2%) | Y: raw vegetables |
| Region of residence | | | 35,367(58%) | Y(women only) |
| Region of residence | | | 14,960(77%) | Y |
| Season: summer or winter | | | 114 | y(women only) |

Key Findings:

- Eating home-grown produce was very significantly associated with higher FV consumption. More than 40% of the men and women in the highest FV consumption quartile consumed home-grown produce.
- People who indicated eating five or more portions of FV/d had a significantly more positive attitude towards their accessibility of FV than people eating two or fewer FV portions/d.
- People who indicated eating five or more portions of FV/d had a significantly less negative attitude towards the affordability of FV than people eating four or fewer FV portions per day.
- Black Americans were 1.54(CI1.11,2.12) times more likely of reaching FV recommendations with a supermarket in the census tract.
- Among men, being married was associated with increased FV intake and being single or divorced/separated was associated with low FV intake.
- Family help and support was significant and positively correlated with FV consumption among women(but not among men)
- The likelihood of being a high FV consumer was 1.62(CI 1.38,1.91) for married women compared with single women.
- Regression co-efficient for social support (family) 0.10(CI0.012,0.18); change in variance 1.9%.
- Regression co-efficient for social support (other) 0.10(CI0.011,0.19); change in variance 1.8%.
- The intellectual-cultural aspect of family functioning (whether the family was concerned about pollitical, social, intellectual and cultural activities) was significantly correlated with FV intake with women.
- Being in receipt of benefits was negatively associated with FV intake.
- Low-income men consumed 1g less FV/d than high income men. Low-income women consumed 35g more FV/d than their high-income counterparts.(significant)
- Low-income men consumed 32 g less FV than high-income men. (significant)
- Among women, living in Scotland was negatively associated with FV intake. (significant)
- Men living in rural areas consumed 47g less FV than those living in cities, whereas women in rural areas

consumed 58g less FV than their counterparts living in cities.(significant)
- Men and women in the most deprived areas consumed 26.5g/d and 16g/d less FV, respectively, compared with their most advantaged counterparts.(significant for men)

Table 5: Results of studies examining environmental determinants of fruit and vegetable (FV) consumption.

| Environmental determinants | Relative | CI | sample size | significance $p \leq 0.05$ |
|---|---|---|---|---|
| **Accessibility factors** | | | | |
| Having home-grown produce | | | 1444(70%) | Y(men and women) |
| shops, choice of FV in shops | | | 680(23%) | Y |
| affordablity | | | 680(23%) | Y |
| supermarkets | 1.08 | 0.89,1.30 | 10,623 | Y(black Americans) |
| **Social factors** | | | | |
| marital status | | | 1444(70%) | Y(men) |
| cohesion aspects of family functioning(helps & supports each other) | | | | Y(women) |
| Having children, married | 1.62 | 1.38,1.91 | 35,367(58%) | Y(married) |
| social support:from family,from others | 0.10 | 0.012,0.18 | 218 | Y(family) |
| **Cultural factors** | 0.10 | 0.011,0.19 | 218 | Y(other) |
| Intellectual-cultural aspect of family functioning | | | 84 | Y(women) |
| **Material factors** | | | | |
| Receiving benefits | - | | 1444(70%) | Y(men and women) |
| Household income | | | 1564(87%) + 3144(63%) | Y(women) |
| Household income | | | 3144(63%) | Y(men) |
| **Other factors** | | | | |
| Region of residence in the UK | | | 1444(70%) | Y(women) |
| Residing in an urban v. rural area in Norway | | | 3144(63%) | Y(men and women) |
| Deprivation of residential area | | | 22562(38%) | Y(men) |

**Author Conclusion:**

The consumption of FV is likely to be higher among people with higher incomes, those who are married, those living in an advantaged neighborhood and/or those who have a good local availability and accessibility of FV. The evidence base is too thin to justify large-scale interventions targeting those environmental determinants. The exception is household income. Interventions to improve opportunities for sufficient FV consumption among low-income households are likely to lead to improved intakes.

***Reviewer Comments:***

*The author clearly discussed the process for reviewing each study presented, including the limitations of the study when interpreting the findings. Some studies did not correct for confounders, thereby possibly overestimating associations. The author admitted that most studies did not report the strength of the association. Therefore, most of my tables show the presence of significance. The strength of the association was difficult to interpret and present.*

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***Research Design and Implementation Criteria Checklist: Review Articles***

| **Relevance Questions** | | |
|---|---|---|
| 1. | Will the answer if true, have a direct bearing on the health of patients? | Yes |
| 2. | Is the outcome or topic something that patients/clients/population groups would care about? | Yes |
| 3. | Is the problem addressed in the review one that is relevant to nutrition or dietetics practice? | Yes |
| 4. | Will the information, if true, require a change in practice? | Yes |

| **Validity Questions** | | |
|---|---|---|
| 1. | Was the question for the review clearly focused and appropriate? | Yes |
| 2. | Was the search strategy used to locate relevant studies comprehensive? Were the databases searched and the search termsused described? | Yes |
| 3. | Were explicit methods used to select studies to include in the review? Were inclusion/exclusion criteria specified and appropriate? Were selection methods unbiased? | Yes |
| 4. | Was there an appraisal of the quality and validity of studies included in the review? Were appraisal methods specified, appropriate, and reproducible? | Yes |
| 5. | Were specific treatments/interventions/exposures described? Were treatments similar enough to be combined? | Yes |
| 6. | Was the outcome of interest clearly indicated? Were other potential harms and benefits considered? | Yes |
| 7. | Were processes for data abstraction, synthesis, and analysis described? Were they applied consistently across studies and groups? Was there appropriate use of qualitative and/or quantitative synthesis? Was variation in findings among studies analyzed? Were heterogeneity issued considered? If data from studies were aggregated for meta-analysis, was the procedure described? | Yes |
| 8. | Are the results clearly presented in narrative and/or quantitative terms? If summary statistics are used, are levels of significance and/or confidence intervals included? | Yes |
| 9. | Are conclusions supported by results with biases and limitations taken into consideration? Are limitations of the review identified and discussed? | Yes |
| 10. | Was bias due to the review's funding or sponsorship unlikely? | Yes |